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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/986,919	11/13/2001	Jeawoan Lee	1567.1021	6274

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EXAMINER	
RUTHKOSKY, MARK	
ART UNIT	**PAPER NUMBER**
1745	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/25/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	09/986,919	LEE ET AL.	
	Examiner	Art Unit	
	Mark Ruthkosky	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 November 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-12,44 and 45* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12,44 and 45* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

The rejection of claims 1-12 and 44 under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement has been overcome by applicant's amendment. Support for the amendment is noted.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-5, 9-12 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu et al. (US 6,030,720) in view of Peled et al. (US Pat. No. 4,410,609.)

The present claims are drawn to a positive electrode comprising a sulfur based active material where the disclosed inventive concept appears to be a positive electrode porous current collector in which the sulfur based active material is disposed. The product-by-process limitations of claims 5, 9, and 10 are not given patentable weight since the courts have held that patentability is based on a product itself, even if the prior art product is made by a different process (see In re Thorpe, 227 USPQ 964, (CAFC 1985), In re Brown, 173 USPQ 685 (CCPA 1972), and In re Marosi, 218 USPQ 289, 292-293 (CAFC 1983)).

In claim 5, the product by process limitation "wherein said porous current collector comprises a resin foam coated with a metal, where the coated resin foam is subjected to a pyrolysis process" is not given patentable weight in a product claim. Therefore, a porous metallic current collector would meet the claim limitation.

In claim 9, the product by process limitation "wherein the metal is coated using a coating method that comprises one of electroplating and electroless plating" is not given patentable weight in a product claim.

In claim 10, the product by process limitation "wherein the metal is coated using a coating method that comprises one of electroplating and electroless plating" is not given patentable weight in a product claim.

Chu et al. disclose a lithium sulfur battery comprising a positive electrode comprising a current collector that can be a conductive foam or a thin conductive grid such as a metal-coated polymer fibers or weaves in which the positive electrode material is interspersed throughout the matrix provided by the current collector (col. 9, lines 15-37 and Figures 2A and 2B). Conductive foam or thin conductive grid such as a metal coated polymer fibers or weaves inherently are porous since they provide a matrix in which the positive electrode material is interspersed. The reference also states that the matrix is sufficiently "open" that there is room for precipitated electroactive material to deposit on the matrix (col. 10, lines 39-56). The positive electrode material is interspersed through the matrix provided by the current collector (col. 9, lines 27-30). Current collector materials may be made of a material such as aluminum that is resist to degradation in the electrochemical environment of the cell (col. 8, lines 13-34).

The active material is disposed in the pores of the collector and is active as the battery produces electricity.

The positive electrode material may be elemental sulfur, sulfides, polysulfides, redox sulfur polymers (col. 6, lines 5-42 and col. 19, lines 6-15), and Li_2S_x where x is a value of 1 or greater (col. 9, lines 40-55). The positive electrode material may be interspersed into the current collector material by providing a slurry containing the sulfur based active material, a suitable ionically conductive binder, electroconductive agent, and solvent (col. 17, lines 24-40) and coating the slurry onto a porous current collector such as carbon fiber paper (col. 17, lines 30-35) where the carbon fiber paper is impregnated with the slurry and the solvent is evaporated (col. 23, lines 23-50 and col. 19, lines 45-58). The ionically conductive polymer binder material may be PEO, PTFE, PAN, PVDF, among others (see col. 18, lines 50-end.) The electroconductive agent may be a carbon black, polyaniline, polythiophene, polyacetylene, polypyrrole, etc. and mixtures thereof (see col. 18, lines 35-50.)

The negative electrode material may be lithium metal, lithium alloy, carbon based-lithium ion that reversibly intercalates and deintercalates lithium ions (col. 21, lines 1-46). A separator separates the positive electrode and the negative electrode and may be glass, plastic, ceramic, or a polymeric entraining liquid electrolyte (col. 8, lines 43-61). The battery contains a liquid electrolyte containing a lithium salt which impregnates (permeates) the negative electrode, positive, electrode, and separator (col. 14, lines 43-67 and col. 16, lines 1-6) and where the electrolyte also transfers lithium metal ions (col. 10, lines 1-6). Chu et al. ('720) do not disclose that the current collector comprises at least 60% porosity and less than 90% porosity based on an overall volume of the current collector.

Peled et al. teach a lithium-sulfur battery comprising a porous positive electrode current where the porosity of the positive electrode current collector is advantageously about 80% or 75-90% (col. 4, lines 1-23). The current collector is charged with sulfur. The active material is disposed in the pores of the collector and is active as the battery produces electricity. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the porosity of the current collector of Chu et al. ('720) to be 80% porous because such porosity would allow for high sulfur loading in the electrode, as noted in the reference, and would provide a cathode with high porosity so as to provide extensive electrolyte solvent communication throughout the bulk of the cathode, which gives improved ionic conductivity in the electrode and improved electrical conductivity with the current collector, which leads to improved battery performance.

Claims 1-5, 9-12 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu (US Patent No. 5,686,201) in view of Peled et al. (US Pat. No. 4,410,609).

The product-by-process limitations of claims 5, 9, and 10 are not given patentable weight as previously noted since the courts have held that patentability is based on a product itself, even if the prior art product is made by a different process (see In re Thorpe, 227 USPQ 964, (CAFC 1985), In re Brown, 173 USPQ 685 (CCPA 1972), and In re Marosi, 218 USPQ 289, 292-293 (CAFC 1983)).

Chu discloses a positive electrode containing active-sulfur based composite electrodes in a lithium sulfur battery (col. 1, lines 15-27 and col. 4, lines 29-60). The positive electrode comprises active sulfur (in the form of elemental sulfur in the examples provided in the

reference), binder and a conductive agent such as carbon black (col. 5, lines 9-43). The current collector to which the positive electrode slurry is applied can be I the form of expanded metals, screens, meshes, and foams as is known in the art (col. 15, lines 3-20). The current collector can be made of aluminum, copper, titanium or other conductive material that would not react at operating cell conditions. The ionically conductive polymer material may be polyethylene oxide, PAN, PVDF, among others (see col. 5, lines 9-25 and col. 6, lines 1-25.) The electroconductive agent may be a carbon black, polyaniline, polythiophene, polyacetylene, polypyrrole, etc. (see col. 12, lines 20-30.) The active material is disposed in the pores of the collector and is active as the battery produces electricity. Chu et al. ('201) do not disclose that the current collector comprises at least 60% porosity and less than 90% porosity based on an overall volume of the current collector.

Peled et al. teach a lithium-sulfur battery comprising a positive electrode current collector that is porous and the porosity of the positive electrode current collector is advantageously about 80% or 75-90% (col. 4, lines 1-23). The active material is disposed in the pores of the collector and is active as the battery produces electricity. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the porosity of the current collector of Chu et al. ('201) to be 80% porous because such porosity would allow for high sulfur loading in the electrode, as noted in the reference, and would provide a cathode with high porosity so as to provide extensive electrolyte solvent communication throughout the bulk of the cathode, which gives improved ionic conductivity in the electrode and improved electrical conductivity with the current collector, which leads to improved battery performance.

With regard to claim 45, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine two electroconductive compositions such as carbon and a conductive polymer as taught in Chu, each of which is taught by the prior art to be useful for the same purpose, in order to form a composition which is to be used for the very same purpose, *In re Kerkhoven*, 205 USPQ 1069, 1072. The artesian would have found the claimed invention to be obvious in light of the teachings of the references.

Claims 6-8, and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu (US Patent No. 5,686,201) in view of Peled et al. (US Pat. No. 4,410,609), as applied to claims 1 and 5 above, and further in view of Kawakami (US Patent No. 6,475,664).

Chu et al. ('201) as modified by Peled et al. disclose all the limitations of claims 6-8, and 44 except that the metal foam comprises a carbon conductive agent other than the metal, that the porous current collector comprises the non-woven fabric coated with a metal, or that the porous current collector comprises a carbon fiber.

Kawakami disclose that current collectors in the form of a metal foam for a positive electrode of a battery can be obtained by 1) coating the surface of a sheet-shaped organic polymer resin having a three dimensional network structure of urethane foam with a metal film of nickel or the like by means of plating or the like and subjecting the resultant to sintering to decompose and remove the polymer resin, or 2) obtained by coating the surface of a carbon fiber felt (which is a nonwoven fabric) with a metal film of nickel or the like by means of plating or the like and such current collectors efficiently supply an electric current consumed in or collect an electric current generated in the electrode reaction upon charging or recharging and

are highly electrically conductive and inactive in a battery reaction (col. 13, lines 62-67 and col. 14, lines 1-14). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a metal foam as a current collector in the battery of Chu ('201) obtained by 1) coating the surface of a sheet-shaped organic polymer resin having a three dimensional network structure of urethane foam with a metal film of nickel or the like by means of plating or the like and subjecting the resultant to sintering to decompose and remove the polymer resin, or 2) obtained by coating the surface of a carbon fiber felt (which is a nonwoven fabric) with a metal film of nickel or the like by means of plating or the like because such metal foam current collectors efficiently supply an electric current consumed in or collect an electric current generated in the electrode reaction upon charging or recharging and are highly electrically conductive and inactive in a battery reaction.

Claims 6-8, and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu et al. (US 6,030,720) in view of Peled et al. (US Pat. No. 4,410,609), as applied to claims 1 and 5 above, and further in view of Kawakami (US Patent No. 6,475,664).

Chu et al. ('720) as modified by Peled et al. disclose all the limitations of claims 6-8, and 44 except that the metal foam comprises a carbon conductive agent other than the metal, that the porous current collector comprises the non-woven fabric coated with a metal, or that the porous current collector comprises a carbon fiber.

Kawakami disclose that current collectors in the form of a metal foam for a positive electrode of a battery can be obtained by 1) coating the surface of a sheet-shaped organic polymer resin having a three dimensional network structure of urethane foam with a metal film

of nickel or the like by means of plating or the like and subjecting the resultant to sintering to decompose and remove the polymer resin, or 2) obtained by coating the surface of a carbon fiber felt (which is a nonwoven fabric) with a metal film of nickel or the like by means of plating or the like and such current collectors efficiently supply an electric current consumed in or collect an electric current generated in the electrode reaction upon charging or recharging and are highly electrically conductive and inactive in a battery reaction (col. 13, lines 62-67 and col. 14, lines 1-14). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a metal foam as a current collector in the battery of Chu ('720) obtained by 1) coating the surface of a sheet-shaped organic polymer resin having a three dimensional network structure of urethane foam with a metal film of nickel or the like by means of plating or the like and subjecting the resultant to sintering to decompose and remove the polymer resin, or 2) obtained by coating the surface of a carbon fiber felt (which is a nonwoven fabric) with a metal film of nickel or the like by means of plating or the like because such metal foam current collectors efficiently supply an electric current consumed in or collect an electric current generated in the electrode reaction upon charging or recharging and are highly electrically conductive and inactive in a battery reaction.

Response to Arguments

Applicant's arguments filed 11/2/2006 have been fully considered but they are not persuasive.

With respect to art rejections based on Chu as modified by Peled, applicant asserts that the references do not active materials disposed in the pores of a collector.

Applicant argues that the amended claims require the sulfur based active materials disposed in the pores of a current collector to allow the positive active mass to remain active even in the absence of the conductive agent in the pores and that the prior art does not teach this feature. This argument is not persuasive. The prior art references teach sulfur based active materials disposed in the pores of a current collector. In the instances where the active materials are in electrical contact with the collector, the positive active mass will inherently remain active even in the absence of the conductive agent in the pores. In each reference, the material that contacts the collector will receive electrons through the conductive collector.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Examiner Correspondence

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mark Ruthkosky whose telephone number is 571-272-1291. The examiner can normally be reached on FLEX schedule (generally, Monday-Thursday from 9:00-6:30.) If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached at 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Mark Ruthkosky
Primary Patent Examiner
Art Unit 1745

1.11.2007